

ATTACHMENT 1
Appendix A
Statement of Work
“Photovoltaic Technologies Beyond the Horizon”
April 12, 2000

1.0 Background

The mission of the U.S. Department of Energy (DOE) National Photovoltaics Program is to make photovoltaics (PV) a significant part of the domestic economy. This mission is described more completely in the Program’s Five Year Research Plan (referenced in the Scope of Work below): Photovoltaics—Energy for the New Millennium: The National Photovoltaics Program Plan for 2000—2004. To meet the Program’s challenge, the program uses a four-pronged strategy: First, we work in close concert with industry and other stakeholders to develop specific goals that serve as significant milestones on the path to achieving a PV technology competitive with other sources for generating electricity. The Program’s Five Year Research Plan also contains the vision, strategies, and goals of the PV Industry Roadmap 2000---2020. Second, we use a vertically integrated development process---including basic research, applied research, engineering, product development, and manufacturing research---to bring technologies from the concept stage to commercial readiness. Third, all along this development process, we collaborate closely with R&D partners from government, industry, and universities. Finally, we validate the technology for specific applications by deploying prototype systems and documenting their performance. This work is performed by the National Center for Photovoltaics (NCPV) and other associated research centers at the National Renewable Energy Laboratory, Sandia National Laboratories, and Brookhaven National Laboratory, and by more than 180 leading companies, universities, and utilities from 40 states across the nation.

Investment in basic scientific research is a long-term economic imperative for our Nation’s technological strength. Science and technology have been, and will continue to be, the engine of U.S. economic growth. The purpose of this project is to nurture basic research directed to identifying and developing non-conventional breakthrough photovoltaic technologies that will be able to compete with other energy technologies used in the world on a large scale.

Today’s photovoltaic technologies for terrestrial applications are based on various forms of crystalline silicon. These technologies---the result of innovative research conducted 30 to 40 years ago---have enabled dozens of companies throughout the world to establish a billion-dollar industry marketing primarily to non-grid-connected applications. Viability in grid-connected applications, however, requires substantial cost reductions---the ultimate goal of all PV R&D efforts. Thin-film technologies, considered the next generation to crystalline-silicon technologies, came into being some 25 or more years ago as non-conventional photovoltaic technologies. DOE funding over the last couple of decades has been critical to their progress. These technologies, based on non-silicon or amorphous silicon materials, are today’s focus of tens of millions of dollars annually for their development.

There is no reason to believe that photovoltaic innovation has gone as far as it can go or that new, viable PV technologies don't exist "beyond the horizon" of our present knowledge. Fundamental and exploratory research is needed to see what can be next. Further, fundamental research can benefit silicon-based technologies, thin-film technologies considered successors to silicon, or help identify totally new PV concepts. This project will support the portfolio of activities in industry, universities, and national laboratories needed to nurture innovation and increase the chances for breakthroughs leading to photovoltaic technologies competitive with conventional renewable and non-renewable energy technologies. The basic research in this project is directed toward the goal of generating inexpensive electricity from sunlight. It is expected to generate new knowledge with a purpose, not knowledge for knowledge's sake.

2.0 Objectives

The objectives of this solicitation are to:

1. Support scientific research leading to non-conventional, breakthrough PV technologies with higher efficiency and lower cost for converting sunlight to electricity.
2. Identify new scientific ideas critical to the foundation of tomorrow's PV research enterprise.
3. Explore non-conventional PV technologies that might "leapfrog" others toward the goal of making a significant contribution to our nation's energy supply and environment.

3.0 Scope of Work

Areas of Interest

The Photovoltaic Technologies Beyond the Horizon solicitation will consider proposals in all areas of photovoltaic-related research, including, but not limited to,

- (a) materials,
- (b) devices,
- (c) measurement and characterization techniques,
- (d) theory, fabrication processes,
- (e) manufacturing, and
- (f) systems.

The latter two areas will be accorded lower priority because of ongoing activities in the DOE program. Responses must address the advancement of PV knowledge expected in the long term, i.e., over the next 5 to 10 years and beyond.

Although highly diverse responses to this solicitation are acceptable and encouraged, several areas are of particular interest to the program. These areas, not in priority order, include:

- (a) dye-sensitized solar cells,
- (b) single-crystal or large-grain thin-films (e.g., GaAs or 1 to 30 microns of Si) on low cost substrates,
- (c) innovative PV concentrators,
- (d) organic solar cells, solar cells based on novel ternary semiconductors,
- (e) solar cells based on nanocrystalline particles or other quantum confinement concepts,
- (f) new multijunction concepts,
- (g) innovative device structures, hybrid device technologies,
- (h) innovative or improved characterization techniques, and
- (i) other promising, non-conventional photovoltaic materials and technologies.

Another area of substantial interest is innovative research that complements our High Performance PV solicitation, which will be posted on the NCPV web site. The High Performance PV solicitation is designed to support research to nearly double the sunlight-to-electricity conversion efficiencies of key PV technologies, accelerating and enhancing their impact in the marketplace. Non-conventional or potential breakthrough technologies as well as directed basic research contributing to the goals of the High-Performance PV project could also be suitable topics for this solicitation.

If appropriate for the topic, proposals complementing or leveraging a national laboratory in-house project in these areas are encouraged. Information on national laboratory in-house projects funded by the DOE PV program is available in the document U.S. Department of Energy Photovoltaic Energy Program Contract Summary—Fiscal Year 1999 (DOE/GO-102000-0976). It is available on the National Center for Photovoltaics Web site (<http://www.nrel.gov/ncpv>). The document provides information on all projects funded during that year by the DOE PV program, including the 18 university contracts awarded as a result of a 1998 solicitation similar to this one: “University R&D for Future-Generation PV Technologies.” One difference is that this solicitation is open to private industry, as well as to universities.

Program parameters

Although this program can lead to non-conventional photovoltaic technologies, it is important that these technologies have the potential for higher performance, lower cost, or higher reliability than near-term and mid-term technologies presently supported by the DOE program. This RFP is not intended to fund near- or mid-term activities similar to those presently funded by DOE’s Thin Film Partnership Program, its PV Manufacturing Research Program, or other projects in its Technology Development and Systems Engineering and Applications areas described in the National Photovoltaic Program Plan. This is not a requirement to exclude technologies presently funded by the program. For example, crystalline silicon-related projects are funded in several program areas, yet the development of thin-film, large-grain, crystalline silicon on low-cost substrates is viewed as a long-term research project. Further, this program could support long-term research concerning fundamental limitations or research generating fundamental understanding of crystalline silicon or other presently funded technologies. Finally, it is understood that a project viewed as long-term might conceivably leap forward and become a mid-term or near-term technology due to an R&D breakthrough.

For offerors unfamiliar with the DOE National Photovoltaics Program, we strongly recommend reading Photovoltaics—Energy for the New Millennium: The National Photovoltaics Program Plan for 2000--2004 on the National Center for Photovoltaics web site (<http://www.nrel.gov/ncpv/pdfs/25847.pdf>). This document also contains the vision, strategies, and goals of the PV Industry Roadmap 2000--2020. It is important for offerors preparing their proposals to understand how the R&D funded through this RFP is part of a balanced program of technology activities, yielding progress in the near-term, mid-term, and long-term. Offerors aware of the Industry Roadmap goals and the DOE mission, goals, and balance of technology activities in its program and who incorporate this knowledge into their proposal may provide the proposal evaluators with grounds for upgrading their proposal’s score.

Additional information on long-term PV technologies is available in the proceedings of NREL's 1997 Future-Generation Photovoltaic Technologies Conference, available from the American Institute of Physics, and the 1999 Electrochemical Society's symposium on Photovoltaics for the 21st Century (see <http://www.aip.org/> and <http://ecs.electrochem.org/>). Many presentations at these conferences referenced a long history for several PV technologies that are not part of today's generation of PV technologies. What has changed, perhaps, is the availability of new enabling technologies and discoveries that might make some of these concepts more realistic and worthy of development.

4.1 Reporting Requirements

The milestones and deliverables for the R&D to allow for appropriate evaluation of progress and reporting requirements are listed below:

- Quarterly Technical Status Reports
- Annual Technical Progress Reports
- Final Technical Report
- Cost Plan
- Deliverables

5.0 Addresses

One copy of each deliverable shall be sent to the following two (2) people:

NREL
Attn: Technical Monitor
1617 Cole Boulevard
Golden, CO 80401

NREL
Attn: Liz Surek, Contract Administrator, M/S 2713
1617 Cole Boulevard
Golden, CO 80401
303-384-7354
303-384-7329 – fax
elizabeth_surek@nrel.gov